Topic 6: - Topic Analysis

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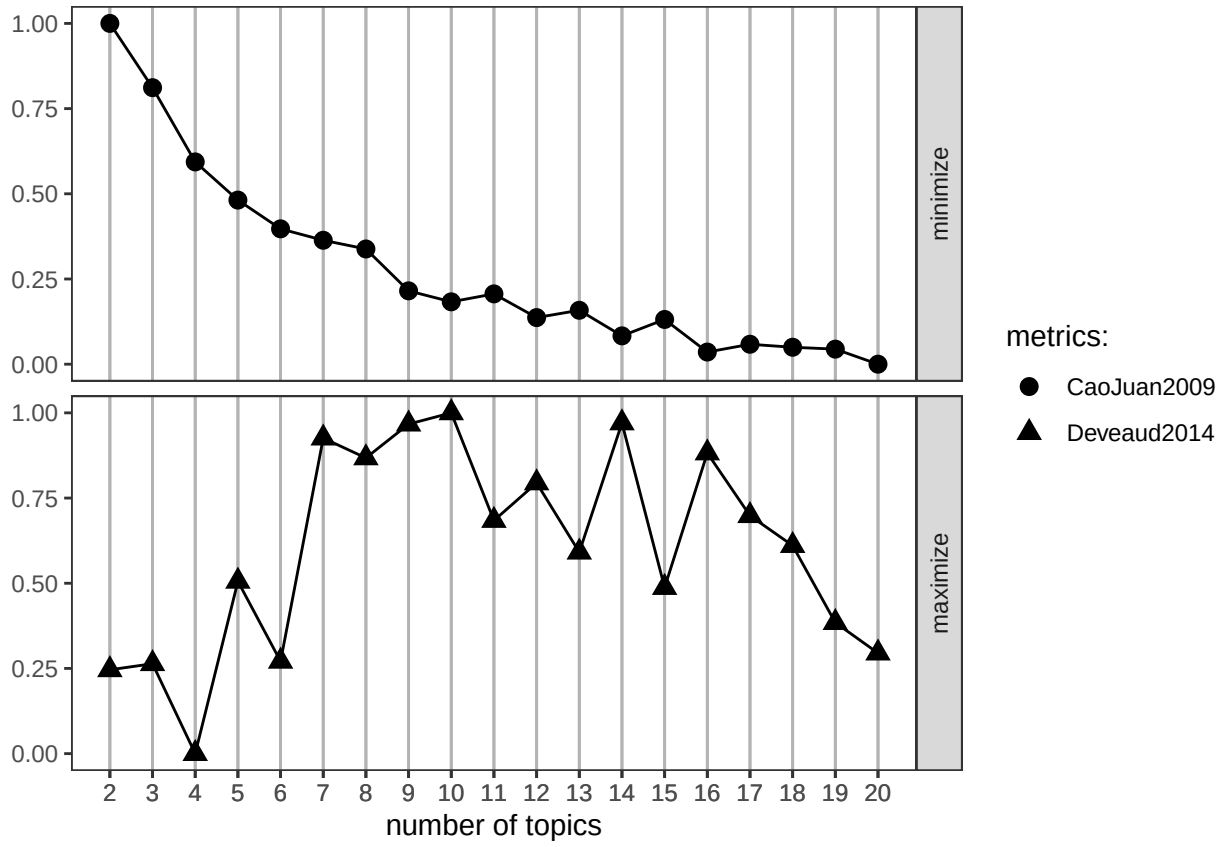
```
## -- read in, clean, and wrangle data -- ##
comments_df<-read_csv(here("data/comments_df.csv"))

epa_corp <- corpus(x = comments_df, text_field = "text")
epa_corp.stats <- summary(epa_corp)
tokens <- tokens(epa_corp, remove_punct = TRUE, remove_numbers = TRUE)

# project-specific stop words
add_stops <- c(stopwords("en"),"environmental", "justice", "ej", "epa", "public", "comment")
tokens_1 <- tokens_select(tokens, pattern = add_stops, selection = "remove")

doc_feature_matric_common <- dfm(tokens_1, tolower = TRUE)
doc_feature_matric <- dfm_wordstem(doc_feature_matric_common)
doc_feature_matric <- dfm_trim(doc_feature_matric, min_docfreq = 2)

# remove rows (docs) with all zeros
select_idx <- slam::row_sums(doc_feature_matric) > 0
doc_feature_matric <- doc_feature_matric[select_idx, ]
```

Calculate value of k that is most likely

```
# calculate what initial value of k is most likely
result <- FindTopicsNumber(
  doc_feature_matric,
  topics = seq(from = 2, to = 20, by = 1),
  metrics = c("CaoJuan2009",  "Deveaud2014"),
  method = "Gibbs",
  control = list(seed = 77),
  verbose = TRUE
)
```

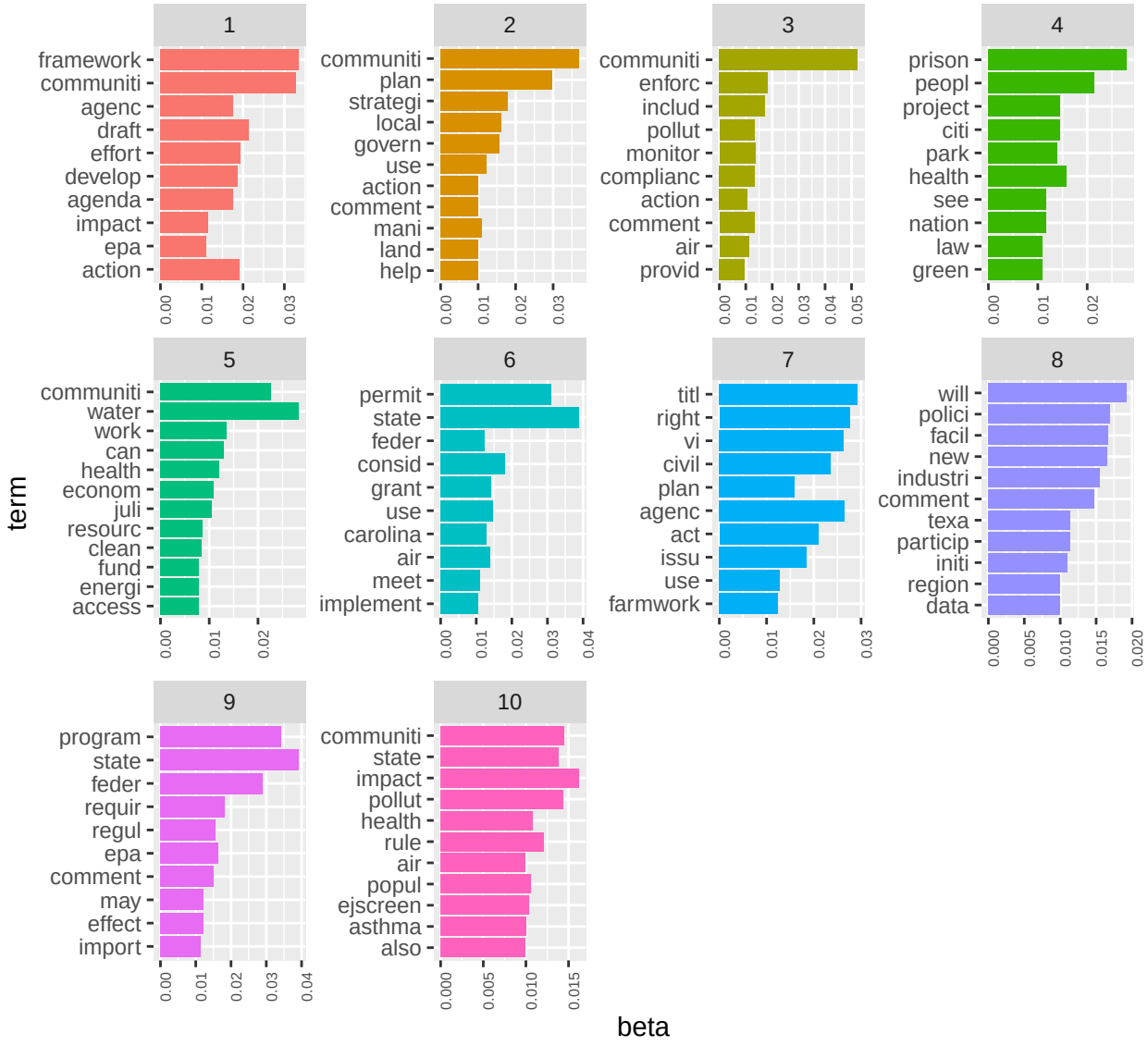
```
FindTopicsNumber_plot(result)
```



Model 1 (k = 10)

```
k <- 10

topicModel_k10 <- LDA(doc_feature_matric, k,
                      method = "Gibbs",
                      control = list(iter = 500, verbose = 25))

tmResult_k10 <- posterior(topicModel_k10)
theta_k10 <- tmResult_k10$topics
beta_k10 <- tmResult_k10$terms # probability of each term in each topic
vocab_k10 <- (colnames(beta_k10))

comment_topic_k10 <- tidy(topicModel_k10, matrix = "beta")

top_terms_k10 <- comment_topic_k10 %>%
  group_by(topic) %>%
  top_n(10, beta) %>%
  ungroup() %>%
  arrange(topic, -beta)
```

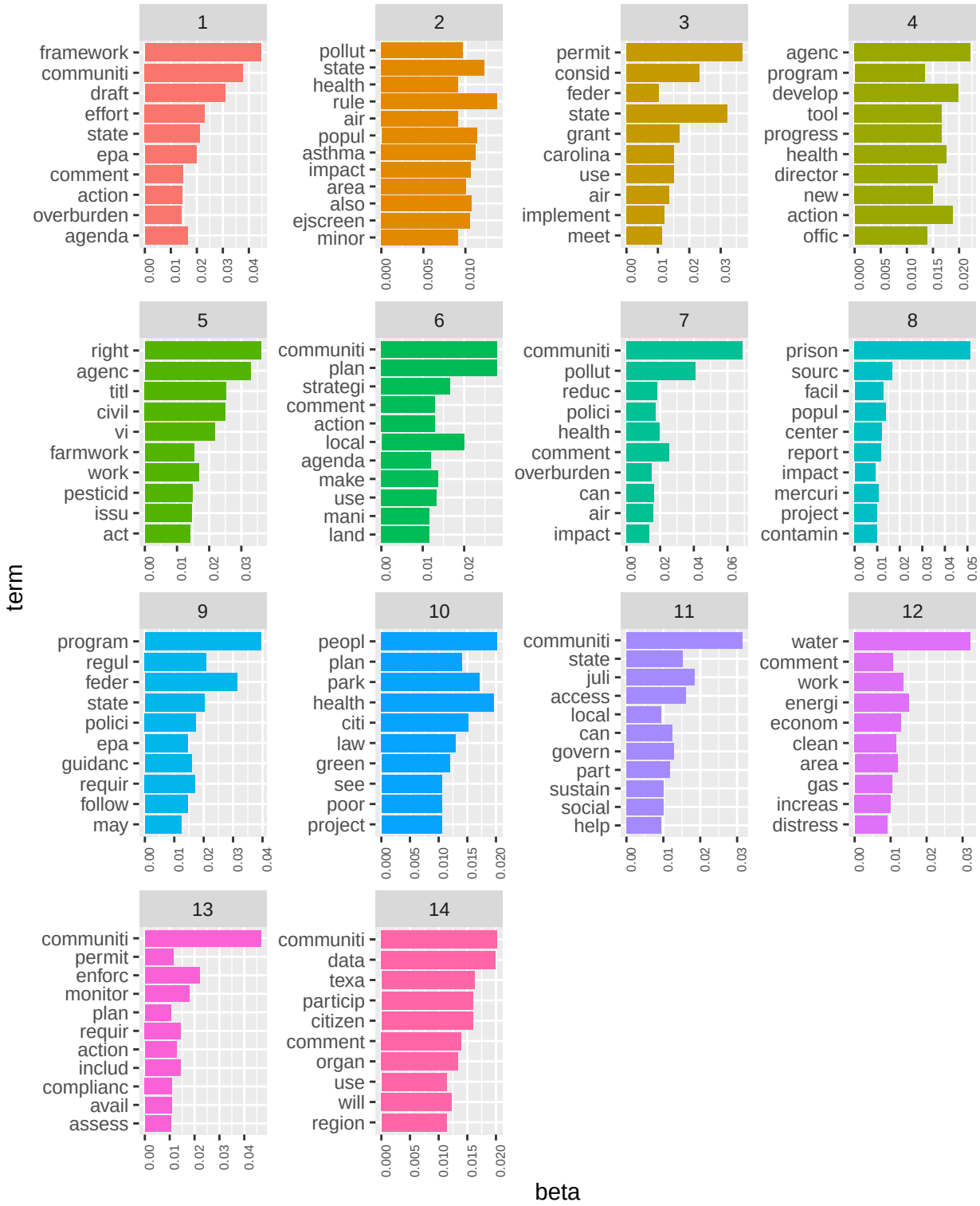
```
top_terms_k10 %>%
  mutate(term = reorder(term, beta)) %>%
  ggplot(aes(term, beta, fill = factor(topic))) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~ topic, scales = "free") +
  coord_flip() +
  theme(axis.text.x = element_text(angle = 90, hjust = 1, size = 6))
```



Model 2 (k = 14)

```
k <- 14

topicModel_k14 <- LDA(doc_feature_matric, k,
                      method = "Gibbs",
                      control = list(iter = 500, verbose = 25))

tmResult_k14 <- posterior(topicModel_k14)
theta_k14 <- tmResult_k14$topics
beta_k14 <- tmResult_k14$terms # probability of each term in each topic
vocab_k14 <- (colnames(beta_k14))

comment_topic_k14 <- tidy(topicModel_k14, matrix = "beta")

top_terms_k14 <- comment_topic_k14 %>%
  group_by(topic) %>%
  top_n(10, beta) %>%
  ungroup() %>%
  arrange(topic, -beta)
```

```
top_terms_k14 %>%
  mutate(term = reorder(term, beta)) %>%
  ggplot(aes(term, beta, fill = factor(topic))) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~ topic, scales = "free") +
  coord_flip() +
  theme(axis.text.x = element_text(angle = 90, hjust = 1, size = 6))
```


1
framework
communiti
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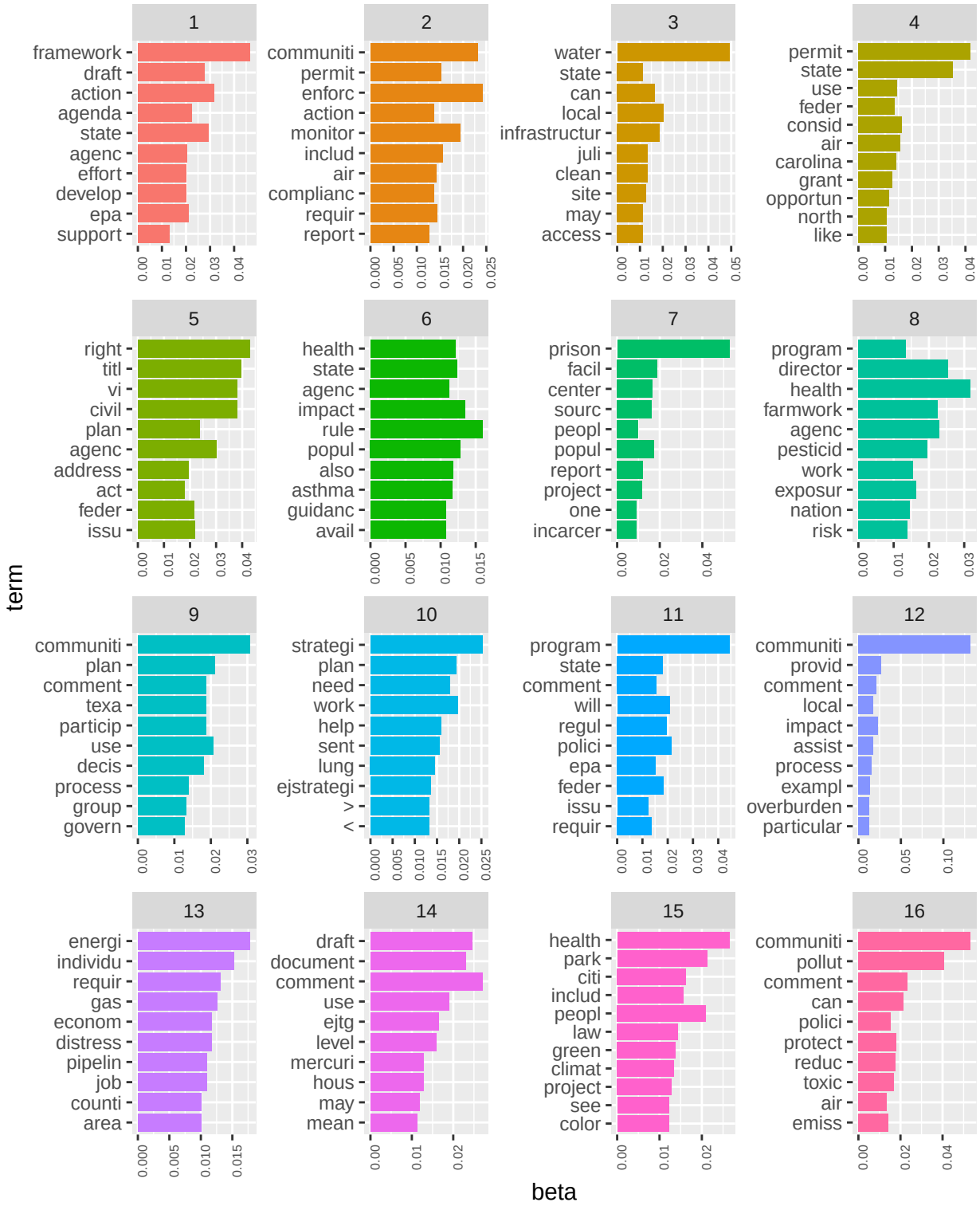
term
beta

Model 3 (k = 16)

```
k <- 16

topicModel_k16 <- LDA(doc_feature_matric, k,
                      method = "Gibbs",
                      control = list(iter = 500, verbose = 25))

tmResult_k16 <- posterior(topicModel_k16)
theta_k16 <- tmResult_k16$topics
beta_k16 <- tmResult_k16$terms # probability of each term in each topic
vocab_k16 <- (colnames(beta_k16))

comment_topic_k16 <- tidy(topicModel_k16, matrix = "beta")

top_terms_k16 <- comment_topic_k16 %>%
  group_by(topic) %>%
  top_n(10, beta) %>%
  ungroup() %>%
  arrange(topic, -beta)
```

```
top_terms_k16 %>%
  mutate(term = reorder(term, beta)) %>%
  ggplot(aes(term, beta, fill = factor(topic))) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~ topic, scales = "free") +
  coord_flip() +
  theme(axis.text.x = element_text(angle = 90, hjust = 1, size = 6))
```


1
framework
draft
action
agenda
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2
communiti
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requir
report
3
water
state
can
local
infrastructur
juli
clean
site
may
access
4
permit
state
use
feder
consid
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carolina
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center
sourc
peopl
popul
report
project
one
incarcer
8
program
director
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farmwork
agenc
pesticid
work
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comment
texa
particip
use
decis
process
group
govern
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strategi
plan
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assist
process
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overburden
particular
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individu
requir
gas
econom
distress
pipelin
job
counti
area
14
draft
document
comment
use
ejtg
level
mercuri
hous
may
mean
15
health
park
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includ
peopl
law
green
climat
project
see
color
16
communiti
pollut
comment
can
polici
protect
reduc
toxic
air
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term
beta

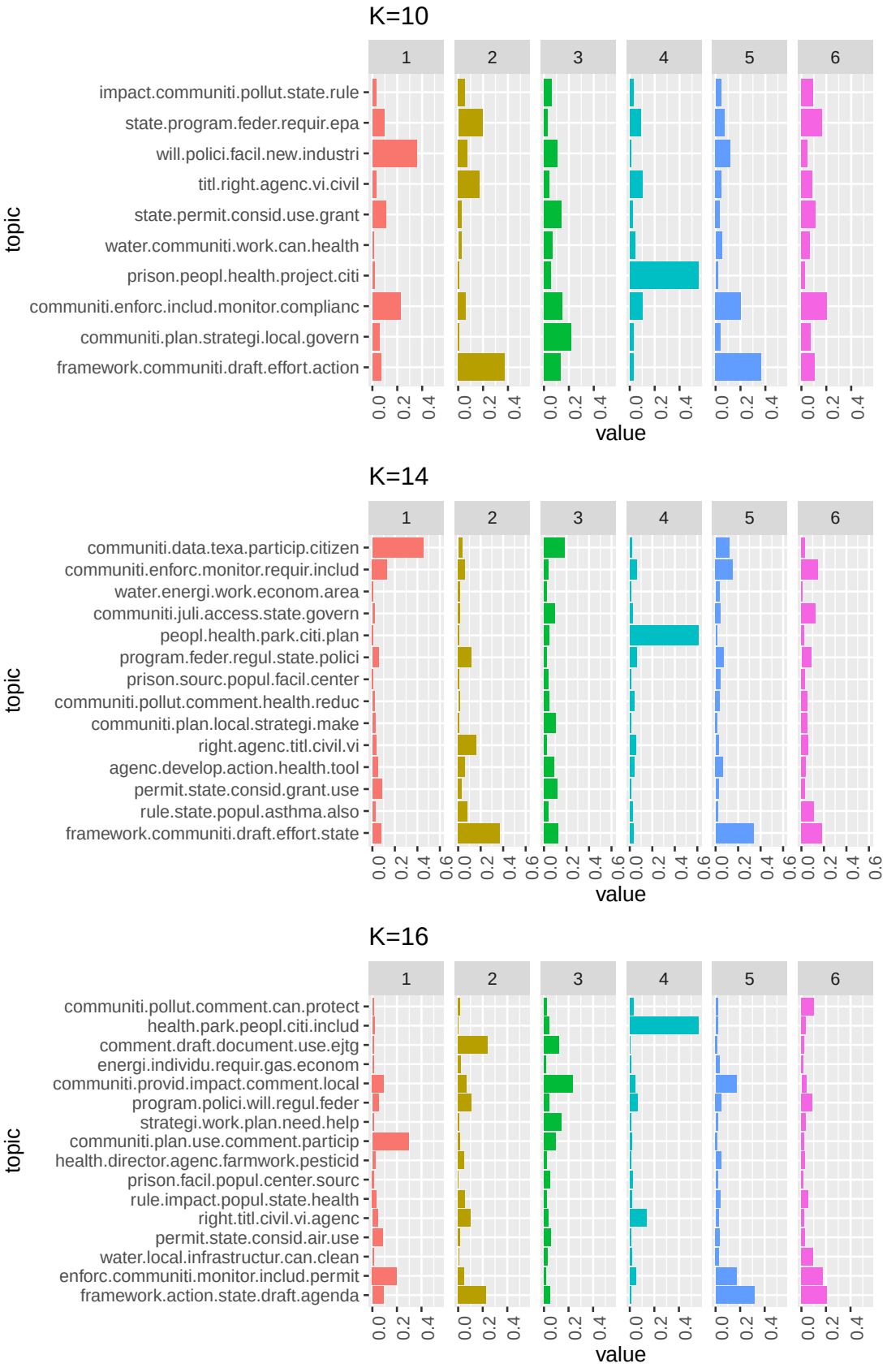
Evaluate best k value

```
docIds <- c(1, 2, 3, 4, 5, 6)
N <- length(docIds)
```

```
## -- k = 10 -- ##
# name each topic based on 1st 5 terms in topic
top5termsPerTopic_k10 <- terms(topicModel_k10, 5)
topicNames_k10 <- apply(top5termsPerTopic_k10, 2, paste, collapse = " ")

# get topic proportions from example documents
topicProportions_K10 <- theta_k10[docIds,]
colnames(topicProportions_K10) <- topicNames_k10

vizDataFrame_k10 <- melt(cbind(data.frame(topicProportions_K10),
                               document = factor(1:N)),
                         variable.name = "topic",
                         id.vars = "document")

plot_k10 <- ggplot(data = vizDataFrame_k10,
                   aes(x = topic,
                       y = value,
                       fill = document),
                   ylab = "proportion") +
  geom_bar(stat="identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1),
        legend.position = "none") +
  coord_flip() +
  facet_wrap(~ document, ncol = N) +
  labs(title = "K=10")


## -- k = 14 -- ##
# name each topic based on 1st 5 terms in topic
top5termsPerTopic_k14 <- terms(topicModel_k14, 5)
topicNames_k14 <- apply(top5termsPerTopic_k14, 2, paste, collapse = " ")

# get topic proportions from example documents
topicProportions_k14 <- theta_k14[docIds,]
colnames(topicProportions_k14) <- topicNames_k14

vizDataFrame_k14 <- melt(cbind(data.frame(topicProportions_k14),
                               document = factor(1:N)),
                         variable.name = "topic",
                         id.vars = "document")

plot_k14 <- ggplot(data = vizDataFrame_k14,
                   aes(x = topic,
                       y = value,
                       fill = document),
                   ylab = "proportion") +
  geom_bar(stat="identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1),
```

```
        legend.position = "none") +
  coord_flip() +
  facet_wrap(~ document, ncol = N) +
  labs(title = "K=14")


## -- k = 16 -- ##
# name each topic based on 1st 5 terms in topic
top5termsPerTopic_k16 <- terms(topicModel_k16, 5)
topicNames_k16 <- apply(top5termsPerTopic_k16, 2, paste, collapse = " ")

# get topic proportions from example documents
topicProportions_k16 <- theta_k16[docIds,]
colnames(topicProportions_k16) <- topicNames_k16

vizDataFrame_k16 <- melt(cbind(data.frame(topicProportions_k16),
                               document = factor(1:N)),
                         variable.name = "topic",
                         id.vars = "document")

plot_k16 <- ggplot(data = vizDataFrame_k16,
                   aes(x = topic,
                       y = value,
                       fill = document),
                   ylab = "proportion") +
  geom_bar(stat="identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1),
        legend.position = "none") +
  coord_flip() +
  facet_wrap(~ document, ncol = N) +
  labs(title = "K=16")
```

```
plot_k10 / plot_k14 / plot_k16
```


K=10
1
2
3
4
5
6
impact.communiti.pollut.state.rule
state.program.feder.requir.epa
will.polici.facil.new.industri
titl.right.agenc.vi.civil
state.permit.consid.use.grant
water.communiti.work.can.health
prison.peopl.health.project.citi
communiti.enforc.includ.monitor.complianc
communiti.plan.strategi.local.govern
framework.communiti.draft.effort.action
topic
0.0
0.2
0.4
value
K=14
communiti.data.texa.particip.citizen
communiti.enforc.monitor.requir.includ
water.energi.work.econom.area
communiti.juli.access.state.govern
peopl.health.park.citi.plan
program.feder.regul.state.polici
prison.sourc.popul.facil.center
communiti.pollut.comment.health.reduc
communiti.plan.local.strategi.make
right.agenc.titl.civil.vi
agenc.develop.action.health.tool
permit.state.consid.grant.use
rule.state.popul.asthma.also
framework.communiti.draft.effort.state
topic
0.0
0.2
0.4
0.6
value
K=16
communiti.pollut.comment.can.protect
health.park.peopl.citi.includ
comment.draft.document.use.ejtg
energi.individu.requir.gas.econom
communiti.provid.impact.comment.local
program.polici.will.regul.feder
strategi.work.plan.need.help
communiti.plan.use.comment.particip
health.director.agenc.farmwork.pesticid
prison.facil.popul.center.sourc
rule.impact.popul.state.health
right.titl.civil.vi.agenc
permit.state.consid.air.use
water.local.infrastructur.can.clean
enforc.communiti.monitor.includ.permit
framework.action.state.draft.agenda
topic
0.0
0.2
0.4
value

```r
svd_tsne <- function(x){
  tsne(svd(x)$u)
  }

json_k10 <- createJSON(
  phi = tmResult_k10$terms,
  theta = tmResult_k10$topics,
  doc.length = rowSums(doc_feature_matric),
  vocab = colnames(doc_feature_matric),
  term.frequency = colSums(doc_feature_matric),
  mds.method = svd_tsne,
  plot.opts = list(xlab = "", ylab = ""))

json_k14 <- createJSON(
  phi = tmResult_k14$terms,
  theta = tmResult_k14$topics,
  doc.length = rowSums(doc_feature_matric),
  vocab = colnames(doc_feature_matric),
  term.frequency = colSums(doc_feature_matric),
  mds.method = svd_tsne,
  plot.opts = list(xlab = "", ylab = ""))

json_k16 <- createJSON(
  phi = tmResult_k16$terms,
  theta = tmResult_k16$topics,
  doc.length = rowSums(doc_feature_matric),
  vocab = colnames(doc_feature_matric),
  term.frequency = colSums(doc_feature_matric),
  mds.method = svd_tsne,
  plot.opts = list(xlab = "", ylab = ""))
```

```r
serVis(json_k16)
```

Picking k values to check Based on the `FindTopicsNumber()` optimization metrics, 9, 10, 14, 16, and 20 are good candidates for k (the number of topics). Based on the plots, 10 is the highest maximum and around where the minimization plot begins to decrease more slowly. In the maximization plot, 14 is the next highest maximum peak and 16 is where the minimization plot begins to level out. We know there are 9 priority areas for the EPA and as discussed in the lab, there are 7 additional topics identified in the EPA's response to the public comments. So this would be a theoretical argument for 16 being the best k value. Based on all of the above, I chose to run three models with k equal to 10, 14, and 16.

Picking the best k value Based on the LDAvis and looking at the graphs of the top terms in each topic I would move forward with using 14 as the overall best value for k. When looking at the top term plots for k=16 as compared to k=14, there appeared to begin to be topics that were related to each other such as topics 14 and 15 in the plot that both reference community actions and participation with government. In looking at the LDAvis, the size of the circles for each topic appear to be evenly sized for k=14. Whereas, for k=16 there are more topics with smaller circles (aka less topic distribution).